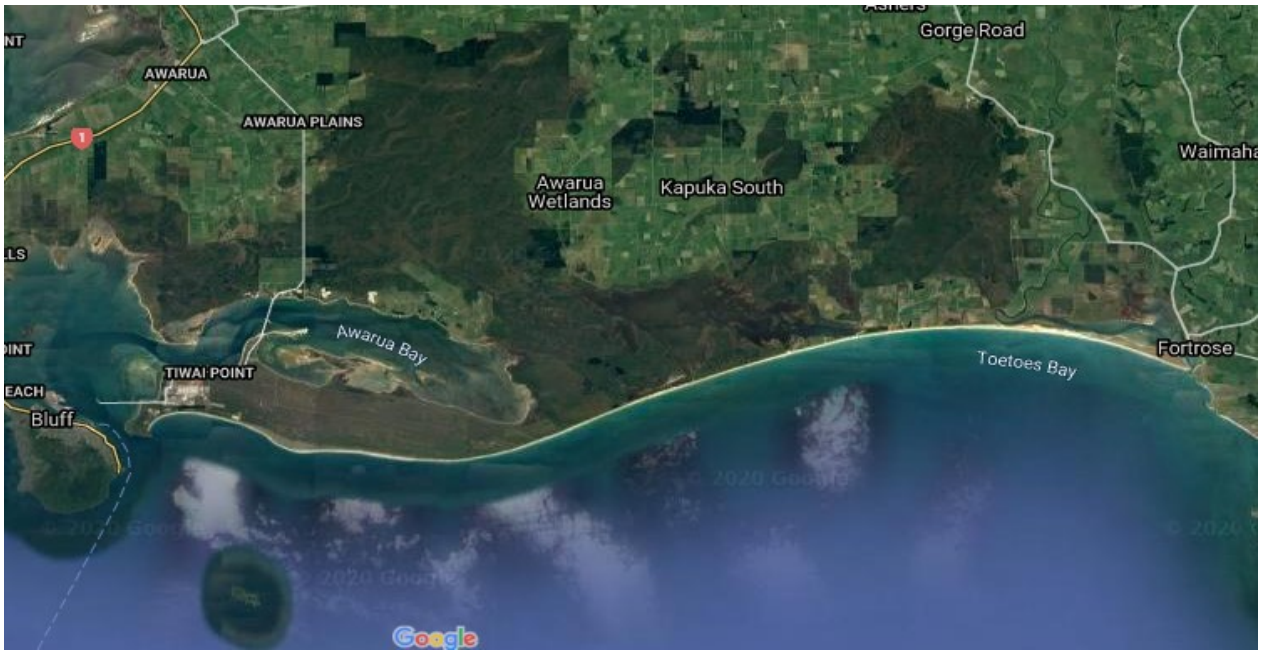
Kyle Craig **07/08/2020**

Marine & Fresh Water Ecology Of Awarua Bay/Tiwai Point:

Introduction:

This report is based on my chosen area of coastline close to me, the Awarua Wetlands and Coastal Estuary at Tiwai, 20km south of Invercargill. This report will assess and describe atleast three factors that contributed to it's formation, and the role of ocean currents on the marine ecosystems along this particular stretch of coastline.



Awarua Wetland Complex:

Adjacent to Toetoes Bay in southern Southland, Awarua extends from Fortrose in the east to Bluff Harbour in the west and comprises a land area of 2,030ha. Awarua plains are made up of peatlands dominated by wire rush and shrubland. The shore-line is characterised by fine gravel beaches and iron stained quartz pebbles. This area contains an estuary at Awarua Bay.
Seaward Downs and Tiwai Point are conservation lands and a small community resides along the bay. Tiwai Aluminium Smelter is situated on the point and opened in 1971, thanks to plentiful electrical supply from the Manapouri Power Station. The plants alumina is imported from Australia and around 90% of the aluminium produced at Tiwai is exported, mostly to Japan.

Factors of Formation:

The Awarua Plains Wetland Complex is a breadth of low-lying land with gentle rigid topography. The large water body of Awarua Bay is estuarine and open to the sea. The bays and shorelines are made up of stones, pebbles and sand that are characteristic of the sandy pebbles found on the mainly flat floor of Foveaux Strait. The sea floor of the strait rose about 6000 years ago and today has a depth of around 50 meters. River gravels reworked by rising sea levels have seen the peat impounded behind a coastal gravel barrier, this is evidence of geo progradation eastward. Periodically, the gravel lagoon barrier of the bay facilitated drainage from surrounding farms, and the flushing of nutrient rich water into the area turned the bay into this esturine state. Aswell as nutrients and sediment entering the waters from the sea, rainfall bequeaths and Awarua Bay is where freshwater drainage and sea water meet. The last glaciation in this area was around 12,000 years ago (Wetland Trust NZ)

Possible Changes in Land:

Privately owned land within the complex could be drained for development or pasture. Lignite or coal-mining activities could begin in the catchment area. Although wetlands are wet, Awarua is susceptible to fire and this remains the major threat. Monitoring of the recovery of the area from an October 2005 fire is still taking place today.
Obnoxious weeds and invasive species are subject to management through the Department of Conservation and the NZAS. (New Zealand Aluminium Smelters)
Tiwai Point Aluminium Smelter might close down soon. Energy and Resources Minister Megan Woods said the government expected Rio Tinto to do the right thing environmentally and clean-up the site.

The Role of Ocean Currents:

Prevailing westerlies often bring rough to stormy weather, and wind driven swells contribute to the wave climate in the catchment areas, home to many species of fish and molluscs. Awarua Bay is an esturine intertidal area and is key to the nourishment of ecosystems as this is where terrestial, fresh-water and marine ecological habitats reside, within this fluvial nutrient cycle. Estuary monitoring is comprised of broad and fine scale habitat mapping and the collection of data based on the National Estuary Monitoring Protocol (robertson et al. 2002)
Varying water depths and the role of photosynthesis along the fringes of the shore provide habitats for marshes, sea grass and rushlands on the mudflats and sand flats, which include a large array of insect life.
Ocean currents and tidal fluctuations release sediment and nutrients from the sea floor and shores, aswell as the mere motion refreshing bodies of water, reducing stagnancy and rejuvinating organisims, flora and fauna. Growth of phytoplankton, zooplankton and photosynthesitic processes provide microbial food-chain sources and food for subsequent insects and birds.

Noteworthy Flora and Fauna:

Awarua plays a significant role in the recharge and discharge of ground water and waste water while sediment trapping processes maintain the overall water quality value, and it's nutrition density. This is of upmost importance in supporting the aquatic and terrestial food-chains around Awarua Bay which in turn directly influence the marine food-chains within the Foveaux Strait.
The Awarua Complex Estuary is one of the top five most important water fowl habitats in New Zealand including the endangered Drottel. For example, of the 81 species of birds recorded in the area 66 are partially or wholly dependent on the esturine environment. Hundreds of international and national migratory

birds flock here from late spring to early autumn. The south side of Awarua Bay is the only regular feeding ground aside from Stewart Island, also providing safe moulting areas. The Southern Black-Backed Gull is a predator within this environment. Following, is a list of birds found in Awarua Bay.

https://www.doc.govt.nz/parks-and-recreation/places-to-go/southland/places/awarua-waituna-wetlands/birds-found-at-awarua-bay/

Awarua provides extensive spawning and nursery areas for fresh-water and marine fish species. 18 species of fish are known in the bay including 5 flatfish, whitebait and introduced trout. Notably, species also include the giant kokopu, the lampery and the long-finned and short-finned eel species. The southern waters of Tiwai Point to Fortrose is home to the Catlins Coast Marine Mammal Sanctuary.
The wetlands also support many sub-alpine insect species including 80 specie of moth, some of which are not found elsewhere. The mudflats support a rich fauna of worms, crustacea and shell-fish, which are a major food supply for waterfowl.

The infertile soils and harsh climate combine to provide conditions which also allow some sub-alpine species of plants to grow around Awarua. Species include comb sedge and bog pine.
The Awarua Plains Wetland and Estuary Complex contains great representative examples of ecosystem associations, and the effect of an ecosystem on another environments ecosystem. The moor-like cushion bog vegetation occuring at sea level is rare in New Zealand. So too is the coastal tussock, rushland wire rush, tangle fern, inaka and a locally uncommon specie of mat-daisy. Noteworthy is Awaruas diversity of both aquatic and terrestial flora and fauna, such is of special value in protecting.

Conclusion:

The Awarua Plains Wetland and Coastal Estuary is one of the most distinctive features of Southland. It's scenic landscape values are important, and for Maori, Awarua was a meaningful source of seafood. Awarua means aisle in Te Reo. Recreational fishing, diving, game-bird hunting, photography and bird watching are amongst most local activity attractions, though there is very limited tourist use.
Issue driven scientific research is undertaken when it is necessary or needed, but there is a proposal to change the status of Seaward and Toetoes Conservation Areas into Scientific Reserves.
Parts of Awarua are regularly used by school groups, and the Department of Conservation runs summer visitor programmes as there is great educational potential combining esturay, coastal, fresh-water and wetland ecologies. Theres heaps to learn from out here and bird-watching is a popular exercise due to the heightened activity of water-fowl on the peninsula.

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Foveaux Strait Te Ara Encyclopedia https://teara.govt.nz/en/1966/foveaux-strait

A Directory of Wetlands in New Zealand (72)

pg347 :https://www.doc.govt.nz/globalassets/documents/science-and-technical/nzwetlands13.pdf

Tiwai Aluminium Smelter https://en.wikipedia.org/wiki/Tiwai_Point_Aluminium_Smelter

https://www.stuff.co.nz/business/300052786/tiwai-point-aluminium-smelter-to-close-1000-jobs-to-go

Geology of the Murihiku Area

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Definitions of Classifications pg8 (3.3)

https://www.es.govt.nz/repository/libraries/id:26gi9ayo517q9stt81sd/hierarchy/environment/water/estuaries/documents/estuarine-reports/Broad%20Scale%20Intertidal%20Habitat%20Mapping%20of%20Awarua%20Bay%202004.pdf

Kyle Craig **12/09/2020**

Unique Characteristics of Fluvial and Lacustrine Freshwater Ecosystems in Southland, New Zealand

Introduction:

This essay will assess and describe salient/unique aspects of The Oreti River Arm and Waihopai Arm into the New River Estuary, freshwater ecosystem which includes both it's fluvial and lacustrine compoments.

New River Estuary:

New River Estuary is a large tidal lagoon 4,100ha in size. It recieves freshwater from large predominantly argrcultural catchments including both the Waihopai and Oreti Rivers. The New River Estuary has a mean depth of ~2m and is bordered by a mix of bush and grazed pasture, vegetation and urban land use. New River Estuary has been significantly affected in the past 150 years by urban and rural development. This includes urban discharge and untreated storm water, past land-fill leaching, toxic industrial and agricultural activities plus run off further up the catchment, all including areas of re-claimed land. To achieve reclaimation of the tidal flats sparta grass was planted and rock groyne walls were built to enhance sedimintation. Clean fill and rubble from demolished buildings was added with top-soil farming the final layer.

Southland lies adjacent to an off-shore section of the plate boundary between the Australian and Pacific tectonic plates. Numerous active faults make up the plate boundary around Fiordland and Southland and ruptures have formed the sea-bed, however little is known about the frequency and size of the earthquakes generated. The Fiordland Subduction Zone, the Psyegur Subduction Zone and the Alpine Fault are all considered when refering to the Southland area in this sense.
Southland is identified amongst the most intense and prolonged period of volcanicity known in the New Zealand region. This attested by linear intrusions of igneous in the Long-Wood Range, Bluff Peninsula and Northern part of Stewart Island and are also known along the northern part of the stratafied syncline.*

Sailient/Unique Characteristics:

Extensive parts of New River estuary is covered by very soft mud that is located in or near natural settlement in and along the banks of the Oreti and Waihopai River Arms.
The Waihopai Arm and Oreti Arm are characteristic to New River Estuary as they form the junction which allows freshwater flow from the lacustrine area of Lake Wakatipu to converge in an esturine environment in line with human development and environmental standards to meet sea-water at the Omaui inlet. Significant development to form the city area of Invercargill and Otatara has reshaped the characteristics and environment of the river arm through waste-water and agricultural runoff. This has required re-claiming land to support thoroughfare, increased erosion and pollution from an old landfill on the East Bank. The estuary supports a note worthy number of semiaquatic bird wildlife.

Waihopai and Oreti Freshwater Ecosystems:

Fluvial: In the Western Waihopai Arm high levels of hydrogen sulfide attribute to rotting macroalgae to the degradation of its freshwater ecosystem, of note is the sea grass, due to contamination from soil particles and nitrates moving through the landscape into the river. The area is habited by didymo, cynobacteriums and microalgae, zooplankton, inverterbrates, introduced fish such as brown trout, large fish such as cod and eel. The Waihopai Arm is also a common recreational spot for seasonal white-baiting. Freshwater insects and birds benefit from healthy freshwater ecosystems but the past and present state of the lower Waihopai and Oreti Rivers is poor although improving.
New Zealand whitebaiting is dependant on the juvenial stage of the 5 native specie of *Galaxias.* The adult stages live and reproduce in freshwater environments but larvae particularly develop in the sea. Cord grass and sea grass, cabbage trees and lawn grass line the banks of the Waihopai and Oreti.

Lacustrine: Aside from New River Estuary itself, Lake Wakatipu is the only first lacustrine compoment to the Oreti River and the Waihopai Dam Wetlands being the first lacustrine environment upstream the Waihopai River. Dynamic characteristics of Lake Wakatipu include it's depth, sand/silt sediment and vast ecosystem, home to native species of fish such as Koaro, Common Bully and common smelt. The lake ecosystem includes biotic plants animals and microorganisms aswell as abiotic physical and chemical interactions. This contributes to the quality of freshwater flow downstream the Oreti River and is a constant flow through acricultural Southland to the New River Estuary. The closest lacustrine compoment of the Waihopai river is at the Waihopai Dam Wetlands Bog (duck pond) popular with season recreational game-bird hunting thanks to the small lagoons rich insect biodiversity and semi-aquatic bird life. Ducks and Black Backed Gull dominate the area and is surrounded by a local farming community and feeds in through the Waihopai Catchment. This is where the lower Waihopai River has been physically modified to compensate storm water outfall. In and around this section aquatic plant growth is prevalant and the surrounding grasses used for pasturization. The area is also subject to power transmission above and is adjacent to a transformer station powering the southern Southland region and the Tiwai Aluminium Smelter at Awarua Bay. There is no evidence the current transmission of high voltage electricity affects any lower laying aquatic ecosystems.

New River Estuary:

New River Estuary is tidal and slow moving and sedimentation fluctuates contributing to the behaviours and circadium rhythms of its ecological inhibitants. To reference the estuary as a lacustrine compoment of the two inflowing Oreti and Waihopai Rivers contributes to the acknowledgment where a medium of sedimentastion allows some now not so fresh freshwater meet the sea. Insect, Bird and plant life benefit from the interactions of these currents and nutrients although water quality and waterbed health are declining, already in unswimmable conditions.

Conclusion:

Eutrophication and toxic levels of nitrates and E. coli from surrounding human activity are threats to the fluvial freshwater ecosystems at the Arms of the New River Estuary. Despite recent efforts to improve water quality, ancient toxins resulting in the rising of rotten macroalgae pollute the surrounding atmosphere and allowing dense growth of invasive species such as cord grass to flourish. Climate Change and a susceptibality to flooding as it has done in the past is likely to increase bank and coastal erosion in the future which could further open up the old landfill on the East Bank and warmer temperatures could see faster water flow and land use further degrading water quality.

REF:

*** = Reference to Facilitator Feedback:**

Waihopai Catchment Report:
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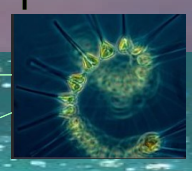
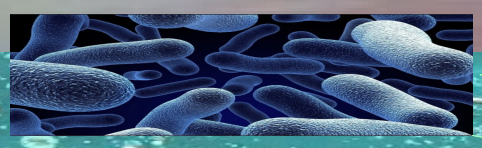
New River Estuary Water Quality:
https://www.es.govt.nz/repository/libraries/id:26gi9ayo517q9stt81sd/hierarchy/environment/water/estuaries/documents/estuarine-reports/New%20River%20Estuary%20Water%20Quality%20Report%202018.pdf

Wetland Type Identification: https://www.wetlandtrust.org.nz/what-we-do/resources/types-of-wetlands/

Catlins Coast Marine Mammal Sanctuary Food Chain

Ultra Violet Sunlight
Feeds Phytoplankton





Marine Bacterium and
Organic matter

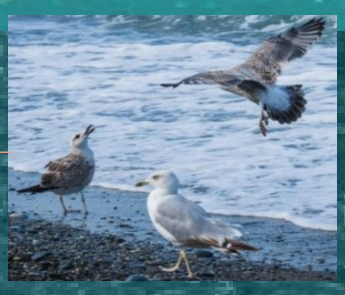
Zooplankton

Producers

Amphipods

1st Order Consumer

Fish and Shell-Fish



Marine Bird's

2nd Order Consumer

Otters/Walrus

Dolphins

Sharks

3rd Order Consumer

Whales

4th Order Consumer

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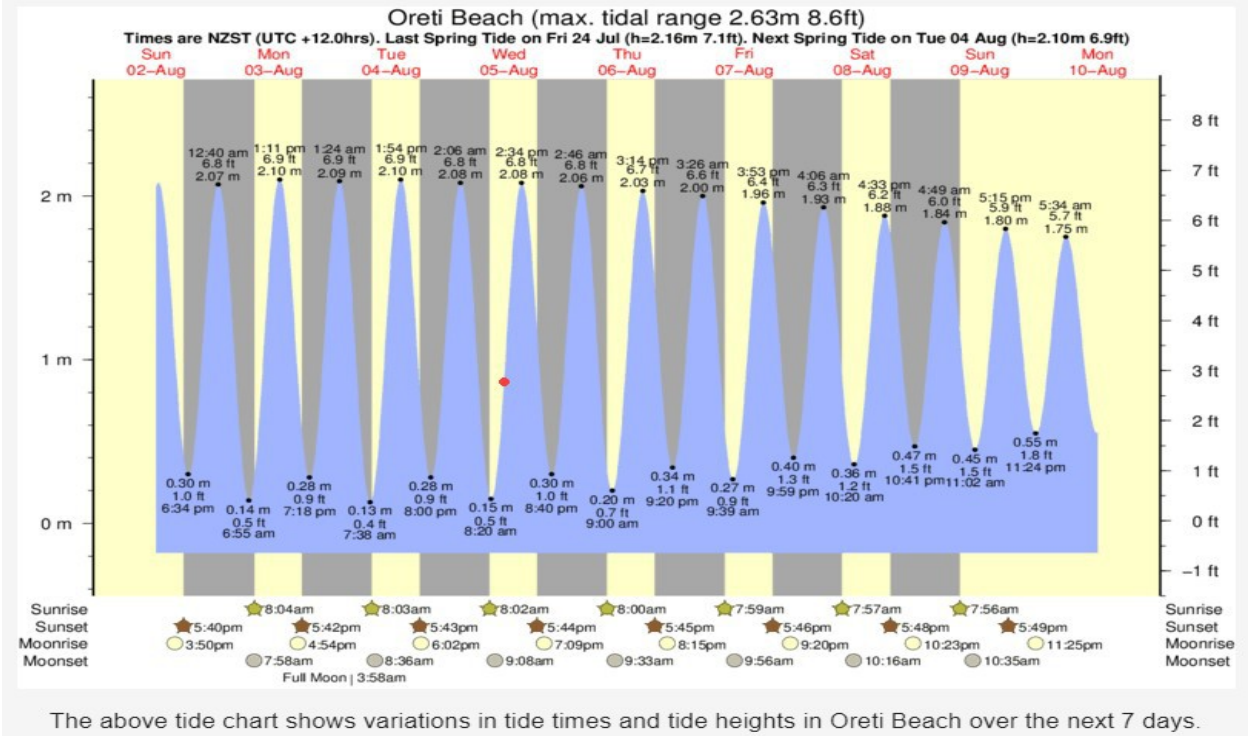
05/08/2020

Local Contributors to Wave Climate

40% of the human population live in coastal areas. Most of the earths water is stored in the ocean, making this a driving force for weather and climate. Wave Climate is defined as the periodic distribution of wave height and direction aswell as the forces that propel them. Like how trends in atmospheric climate can be referred to as 'average weather' and we can grasp how, why and where these weather systems fluctuate, the same goes for areas of the sea and the winds that drive the average behaviours of coastal tides. Gauging wave climate is becoming ever more important in the face of climate change as wave climate can effect coastal populations just as much as atmospheric weather. Large waves can cause destruction, breach flood barriers, disrupt harbour traffic or make boating dangerous, plus contaminate fresh-water reservoirs and erode shore lines and cliff faces.

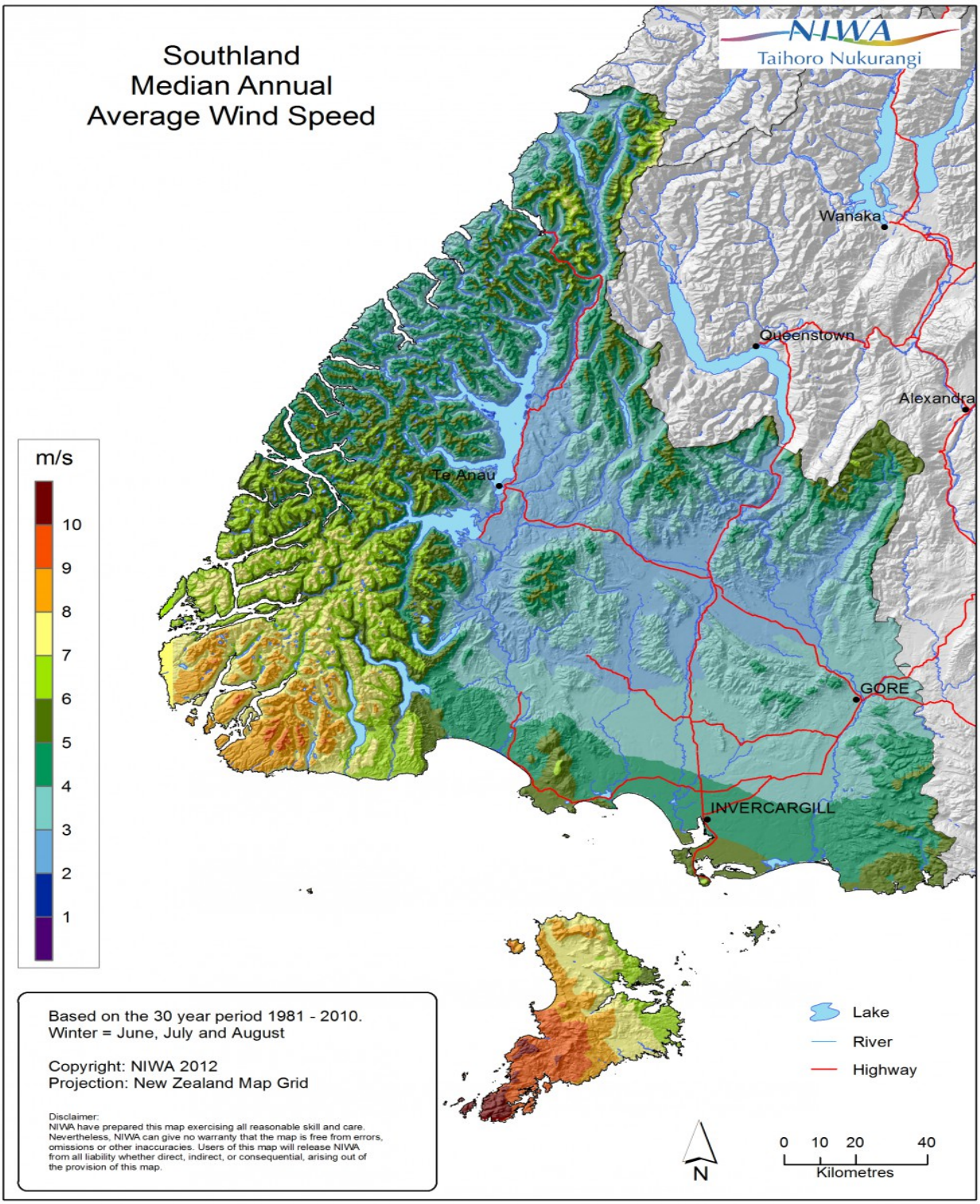
Southland, New Zealand:

'Alone in a wild ocean' the South and South-West of the country is home to the roaring 40s. Strong West to East air currents caused by hot air rising from the equator, being displaced towards the South-Pole by the earths rotation. Driven from the Southern Hemisphere temperate zone, Southland recieves westerly winds of all levels to an exposed shore-line and rising mountain range.



The above tide chart shows variations in tide times and tide heights in Oreti Beach over the next 7 days.

Understanding the connectedness of the catchment to the coast and the influence human maritime activity has on the area is considered by the Ministry of the Environment as it is clear that a healthy water catchment provides quality drinking water and supports livlihood. Winds, waves and tides all contribute to our coastal climate across different seasons building and eroding the physical features of the coast. Ocean water temperature and gravitational disturbances alter the behaviour of mean tides and its impacts on the sea shore. Human activity in this environment is now becoming better understood as our knowledge on wave climate increases.



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